

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT				1. CONTRACT ID CODE <div style="text-align: center;">J</div>		PAGE OF PAGES <div style="text-align: center;">1   3</div>	
2. AMENDMENT/MODIFICATION NO. <div style="text-align: center;">0003</div>		3. EFFECTIVE DATE <div style="text-align: center;">26-Aug-2005</div>		4. REQUISITION/PURCHASE REQ. NO. <div style="text-align: center;">W16ROE-5193-5922</div>		5. PROJECT NO.(If applicable)	
6. ISSUED BY USA ENGINEER DISTRICT, NEW YORK ATTN:CENAN-CT ROOM 1843 26 FEDERAL PLAZA NEW YORK NY 10278		CODE <div style="text-align: center;">W912DS</div>		7. ADMINISTERED BY (If other than item 6) <div style="text-align: center; font-weight: bold;">See Item 6</div>			
8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)				<input checked="" type="checkbox"/> 9A. AMENDMENT OF SOLICITATION NO. W912DS-05-B-0016			
				<input checked="" type="checkbox"/> 9B. DATED (SEE ITEM 11) 09-Aug-2005			
				10A. MOD. OF CONTRACT/ORDER NO.			
				10B. DATED (SEE ITEM 13)			
CODE		FACILITY CODE					
11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS							
<input checked="" type="checkbox"/> The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer <input type="checkbox"/> is extended, <input checked="" type="checkbox"/> is not extended. Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning <u>1</u> copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.							
12. ACCOUNTING AND APPROPRIATION DATA (If required)							
13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.							
A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.							
B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).							
C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:							
D. OTHER (Specify type of modification and authority)							
E. IMPORTANT: Contractor <input type="checkbox"/> is not, <input type="checkbox"/> is required to sign this document and return _____ copies to the issuing office.							
14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.) The purpose of this amendment is to make changes to the plans and specifications as detailed on the following page.  The bid opening date has not been changed.  Note: Bidders must acknowledge receipt of this amendment by the date specified in the solicitation (or as amended) by one of the following methods: In the space provided on the SF1442, by separate letter, or by telegram, or by signing the block 15 below. FAILURE TO ACKNOWLEDGE AMENDMENTS BY THE DATE AND TIME SPECIFIED MAY RESULT IN REJECTION OF YOUR BID IN ACCORDANCE WITH THE LATE BID, LATE MODIFICATIONS OF BIDS OR LATE WITHDRAWAL OF BIDS (FAR 14.304)							
Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.							
15A. NAME AND TITLE OF SIGNER (Type or print)				16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)			
				TEL: _____ EMAIL: _____			
15B. CONTRACTOR/OFFEROR  _____ (Signature of person authorized to sign)		15C. DATE SIGNED		16B. UNITED STATES OF AMERICA  BY _____ (Signature of Contracting Officer)		16C. DATE SIGNED  26-Aug-2005	

## SECTION SF 30 BLOCK 14 CONTINUATION PAGE

**SUMMARY OF CHANGES**

## SECTION SF 30 - BLOCK 14 CONTINUATION PAGE

The following have been added by full text:

AMENDMENT 0003

**AMENDMENT #0003**

**AMENDED DRAWINGS AND SPECIFICATIONS FOR Force Modernization Educational/Transitional Facility, Fort Drum, New York, W912DS-05-B-0016;**

**TO OFFERORS**

The following changes shall be made to the drawings and specifications.

**DRAWINGS**

1. The drawings below have been **REVISED** and **REISSUED**:

**A-300-** "SECTIONS"

**A-301-** "LONGITUDINAL SECTION"

**S-201-** "TYPICAL FRAME ELEVATION"

**E-001-** "ELECTRICAL LEGEND, ABBREVIATIONS & GENERAL NOTES"

**E-104-** "FIRST FLOOR PLAN-POWER & COMMUNICATIONS I"

**E-105-** "FIRST FLOOR PLAN-POWER & COMMUNICATIONS II"

**E-106-** "SECOND & ATTIC FLOOR PLAN-POWER & COMMUNICATIONS"

**SPECIFICATIONS**

1. The specification sections below are revised and **REISSUED** with this amendment:

**Section 09915 – COLOR SCHEDULE**

**Section 15569A- WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH**

2. The specifications below are **REVISED** as indicated.

**Section 08710 - Door Hardware:** delete paragraph 2.3.4.4 Entry Proximity Locks, in its entirety without substitution.

**Section 11020 –Security Vault Door:** delete all reference made to "day gate" and add the following sentence to paragraph 2.1: Style key change combination lock shall be Sergeant & Greenleaf model 8560 (UL Group 1R) lock or approved equal by the Contracting Officer".

**Section 13856 – Carbon Monoxide Detectors:** delete this section in its entirety without substitution.

**NFPA References:** the NFPA publications, as referenced in the specifications, are updated as indicated below:

NFPA 13 (2002); NFPA 24 (2002); NFPA 31 (2001); NFPA 37 (2002); NFPA 50 (2001);  
NFPA 54 (2002); NFPA 70 (2005); NFPA 70E (2004); NFPA 72 (2002); NFPA 85 (2004);  
NFPA 90A (2002); NFPA 96 (2004); NFPA 101 (2003); NFPA 211 (2003); NFPA 241 (2004);  
NFPA 255 (2000); NFPA 780 (2004); NFPA 1963 (2003)

(End of Summary of Changes)

## SECTION 09915

## COLOR SCHEDULE

08/02

## PART 1 GENERAL

## 1.1 GENERAL

This section covers only the color of the exterior and interior materials and products that are exposed to view in the finished construction. The word "color" as used herein includes surface color and pattern. Requirements for quality and method of installation are covered in other appropriate sections of the specifications. Specific locations where the various materials are required are shown on the drawings. Items not designated for color in this section may be specified in other sections. When color is not designated for items, the Contractor shall propose a color for approval.

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-04 Samples

## Color Schedule; G, RO

Three sets of color boards, 120 days after the Contractor is given Notice to proceed, complying with the following requirements:

- a. Color boards shall reflect all actual finish textures, patterns, and colors required for this contract.
- b. Materials shall be labeled with the finish type, manufacturer's name, pattern, and color reference.
- c. Samples shall be on size 8-1/2 by 11 inch boards with a maximum spread of size 25-1/2 by 33 inches for foldouts.
- d. Samples for this color board are required in addition to samples requested in other specification sections.
- e. Color boards shall be submitted to the following address:

Resident Engineer Office, USACE, NYD  
4884 Jones Street  
Fort Drum, NY 13602

## PART 2 PRODUCTS

## 2.1 REFERENCE TO MANUFACTURER'S COLOR

Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal colors from other manufacturers.

## 2.2 COLOR SCHEDULE

The color schedule lists the colors required for exterior and interior finishes, including both factory applied and field applied colors. Refer to FINISH SCHEDULE on drawing A-600 for manufacturer information. Color schedule shall be in compliance with the Fort Drum Architectural Compliance Board Matrix.

## 2.2.1 Exterior Walls

Exterior wall colors shall apply to exterior wall surfaces including recesses at entrances and projecting vestibules. Conduit shall be painted to closely match the adjacent surface color. Wall color shall be provided to match the colors listed below.

## 2.2.1.1 Metal Wall Panels, Hardware, and Associated Trim:

PT-4.

## 2.2.1.2 Glass and Glazing:

Refer to Section 08800 GLAZING and drawing A-602.

## 2.2.2 Exterior Trim

Exterior trim shall be provided to match the colors listed below.

## 2.2.2.1 Steel Doors and Door Frames:

Shall match PT-4.

## 2.2.2.2 Aluminum Store Front Doors and Door Frames:

Shall match PT-5.

## 2.2.2.3 Aluminum Windows Frames:

Shall match Federal Color #27886.

## 2.2.2.4 Fascia:

Shall match PT-5.

## 2.2.2.5 Soffits and Ceilings:

Shall match PT-5.

## 2.2.2.6 Overhangs:

Shall match PT-5.

## 2.2.2.7 Louvers and Flashings:

Shall match PT-4.

## 2.2.2.8 Coping:

Shall match PT-5.

## 2.2.2.9 Caulking and Sealants:

Shall be as determined by Resident Office.

## 2.2.2.10 Stringers and Stair Framing:

Shall be as determined by Resident Office.

## 2.2.2.11 Control Joints:

Shall be as determined by Resident Office.

## 2.2.2.12 Handrails:

Shall match PT-5.

## 2.2.2.13 Signage:

Shall be as determined by Resident Office.

## 2.2.3 Exterior Roof

Roof color shall apply to exterior roof surfaces including sheet metal flashings and copings, mechanical units, roof trim, pipes, conduits, electrical appurtenances, and similar items. Roof color shall be provided to match the colors listed below.

## 2.2.3.1 Metal:

PT-5.

## 2.2.3.2 EPDM:

Standard color.

## 2.2.3.3 Penetrations:

Shall match roof in color.

## 2.2.4 Interior Floor Finishes

Flooring materials shall be provided to match the colors listed below. Refer to FINISH SCHEDULE on drawing A-600.

## 2.2.4.1 Carpet:

CPT-1.

## 2.2.4.2 Vinyl Composition Tile:

VCT-1.

## 2.2.4.3 Stair Treads, Kick Strips, and Risers:

Shall be as determined by Resident Office.

## 2.2.4.4 Quarry Tile:

QT-1.

## 2.2.4.5 Ceramic Tile:

CMT-1.

## 2.2.4.6 Grout:

GT-1, GT-2.

## 2.2.4.7 Concrete Paint and Stain:

Refer to FINISH SCHEDULE on drawing No. A-600.

## 2.2.4.8 Industrial Floor Coating:

Refer to FINISH SCHEDULE on drawing A-600.

## 2.2.5 Interior Base Finishes

Base materials shall be provided to match the colors listed below.

## 2.2.5.1 Resilient Base and Moldings:

RB-1, RB-2.

## 2.2.5.2 Quarry Tile:

QT-1.

## 2.2.5.3 Ceramic Tile:

CMT-1.

## 2.2.5.4 Grout:

GT-1, GT-2.

## 2.2.6 Interior Wall Finishes

Interior wall color shall apply to the entire wall surface, including reveals, vertical furred spaces, grilles, diffusers, electrical and access panels, and piping and conduit adjacent to wall surfaces unless otherwise specified. Items not specified in other paragraphs shall be painted to match adjacent wall surface. Wall materials shall be provided to match the colors listed below. Refer to FINISH SCHEDULE on drawing A-600 for locations.

## 2.2.6.1 Paint:

PT-1, PT-2, PT-7, PT-8.

## 2.2.6.2 Ceramic Tile:

CT-1.

## 2.2.6.3 Ceramic Tile Grout:

GT-1.

## 2.2.6.4 Metal Liner Panels:

PT-1.

## 2.2.7 Interior Ceiling Finishes

Ceiling colors shall apply to ceiling surfaces including soffits, furred down areas, grilles, diffusers, registers, and access panels. Ceiling color shall also apply to joist, underside of roof deck, and conduit and piping where joists and deck are exposed and required to be painted. Ceiling materials shall be provided to match the colors listed below. Refer to FINISH SCHEDULE on drawing No. A-600 for locations.

## 2.2.7.1 Acoustical Tile and Grid:

ACT-1, ACT-2.

## 2.2.7.2 Paint:

PT-3, PT-7.

## 2.2.7.3 Metal Deck:

PT-1.

## 2.2.7.4 Structural Framing:

PT-1.

## 2.2.8 Interior Trim

Interior trim shall be provided to match the colors listed below.

## 2.2.8.1 Metal Doors:

PT-6.

## 2.2.8.2 Metal Door Frames:

PT-6.

## 2.2.8.3 Aluminum Store Front Doors and Door Frames:

Shall match PT-5.

## 2.2.8.4 Aluminum Windows (mullion, muntin, sash, trim, and sill):

Shall be as determined by Resident Office.

## 2.2.8.5 Window Sills:

Shall be as determined by the Resident Office.

## 2.2.8.6 Handrails:

Shall be as determined by the Resident Office.

## 2.2.8.7 Exposed Ductwork:

PT-1.

## 2.2.9 Interior Miscellaneous

Miscellaneous items shall be provided to match the colors listed below.

## 2.2.9.1 Toilet Partitions and Urinal Screens:

TP-1.

## 2.2.9.2 Plastic Laminate:

PLAM-1, PLAM-2.

## 2.2.9.3 Signage Message Color:

White. Refer to drawings A-800 and A-801.

## 2.2.9.4 Signage Background Color:

Black. Refer to drawings A-800 and A-801.

## 2.2.9.5 Operable Partitions:

Beige.

## 2.2.9.6 Corner Guards:

Shall match wall color.

## 2.2.9.7 Wall Switch Handles and Standard Receptacle Bodies:

Shall be as determined by Resident Office.

## 2.2.9.8 Electrical Device Cover Plates:

Shall be as determined by Resident Office.

## 2.2.9.9 Electrical Panels:

Shall be as determined by Resident Office.

## 2.2.9.10 Shower Curtain:

White.

2.2.9.11 Shower Pan:

Off white.

PART 3 EXECUTION (Not Applicable)

-- End of Section --

## SECTION 15569A

WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH  
10/04

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 801 (2001) Industrial Process/Power Generation  
Fans: Specification Guidelines

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.13 (2001; A 2002) Gas-Fired Low-Pressure  
Steam and Hot Water Boilers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
ENGINEERS (ASHRAE)

ASHRAE 52.1 (1992) Gravimetric and Dust-Spot  
Procedures for Testing Air-Cleaning  
Devices Used in General Ventilation for  
Removing Particulate Matter

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606 (2004) Grooved and Shouldered Joints

## AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 (1992) Filler Metals for Brazing and Braze  
Welding

AWS B2.2 (1991) Brazing Procedure and Performance  
Qualification

## ASME INTERNATIONAL (ASME)

ASME B1.20.1 (1983; R 2001) Pipe Threads, General  
Purpose, Inch

ASME B16.11 (2002) Forged Fittings, Socket-Welding and  
Threaded

ASME B16.15 (1985; R 2004) Cast Bronze Threaded  
Fittings Classes 125 and 250

ASME B16.18 (2002) Cast Copper Alloy Solder Joint  
Pressure Fittings

ASME B16.20	(2000) Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral Wound, and Jacketed
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.5	(2003) Pipe Flanges and Flanged Fittings
ASME B16.9	(2003) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2004) Power Piping
ASME B31.5	(2001) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2001) Boiler and Pressure Vessel Code; Section IV, Recommended Rules for the Care and Operation of Heating Boilers
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME CSD-1	(2002) Control and Safety Devices for Automatically Fired Boilers

## ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2003) Carbon Steel Forgings for Piping Applications
ASTM A 167	(2004) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 183	(2003) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2004c) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234/A 234M	(2004) Piping Fittings of Wrought Carbon

	Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 515/A 515M	(2003) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(2004) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 2004) Ductile Iron Castings
ASTM A 653/A 653M	(2004a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 32	(2004) Solder Metal
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 813	(2000e1) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 828	(2002) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B 88	(2003) Seamless Copper Water Tube
ASTM B 88M	(2003) Seamless Copper Water Tube (Metric)
ASTM D 2000	(2003ae1) Rubber Products in Automotive Applications
ASTM D 596	(2001) Reporting Results of Analysis of Water

## COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(1994; R 1995) Copper Tube Handbook
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## HYDRONICS INSTITUTE DIVISION OF GAMA (HYI)

HYI-005	(2004) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial)
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## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and
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## Flared Ends

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2002) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-73	(2003) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(2002) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2002) National Fuel Gas Code
NFPA 85	(2004) Boiler and Combustion Systems Hazards Code

## UNDERWRITERS LABORATORIES (UL)

UL 795	(1999) Commercial-Industrial Gas Heating Equipment
UL Gas&Oil Dir	(2003) Flammable and Combustible Liquids and Gases Equipment Directory

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

## Piping Installation Installation

Detail drawings consisting of equipment layout including installation details and electrical connection diagrams; combustion and safety control diagrams; ductwork layout showing the location of supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of guides and anchors, the load imposed on each support or anchor (not required for radiant floor tubing), and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

## SD-03 Product Data

### Materials and Equipment

Manufacturer's catalog data shall be included with the detail drawings for the following items:

Boilers  
Unit Heaters  
Fuel Burning Equipment  
Combustion Control Equipment  
Pumps  
Fittings and Accessories

The data shall show model, size, options, etc., that are intended for consideration. Data submitted shall be adequate to demonstrate compliance with contract requirements. Data shall include manufacturer's written installation instructions and manufacturer's recommendations for operation and maintenance clearances for each item.

### Spare Parts

Spare parts data for each different item of material and equipment specified.

### Boiler Water Treatment

Six complete copies of the proposed water treatment plan. The plan shall include a layout, control scheme, a list of the existing water conditions including the items listed in paragraph BOILER WATER TREATMENT, a list of all chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

Heating System Tests  
Fuel System Tests  
Unit Heaters

Proposed test procedures for the heating system tests and fuel system tests, at least 2 weeks prior to the start of related testing.

### Welding

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

### Qualifications

A statement from the firms proposed to prepare submittals and perform installation and testing, demonstrating successful completion of similar services of at least five projects of similar size or scope, at least 2 weeks prior to the submittal of any other item required by this section.

### Field Instructions

System layout diagrams that show the layout of equipment, piping, and ductwork and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system, framed under glass or laminated plastic, at least 2 weeks prior to the start of related testing. After approval, these items shall be posted where directed.

### Tests

Proposed test schedules for the heating system and fuel system tests, at least 2 weeks prior to the start of related testing.

## SD-06 Test Reports

### Heating System Tests

#### Fuel System Tests

Test reports for the heating system tests and the fuel system test, upon completion of testing complete with results.

### Water Treatment Testing

.....a. The water quality test report shall identify the chemical composition of the boiler water. The report shall include a comparison of the condition of the boiler water with the manufacturer's recommended conditions. Any required corrective action shall be documented within the report.

b. A test report shall identify the condition of the boiler at the completion of 1 year of service. The report shall include a comparison of the condition of the boiler with the manufacturer's recommended operating conditions.

## SD-07 Certificates

### Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

#### Continuous Emissions Monitoring

Written certification by the boiler manufacturer that each boiler furnished complies with Federal, state, and local regulations for emissions. The certification shall also include a description of applicable emission regulations. If any boiler is exempt from the emission regulations, the certification shall indicate the reason for the exemption.

### SD-10 Operation and Maintenance Data

#### Operation and Maintenance Instructions

Six complete manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

#### Water Treatment System

Six complete copies of operating and maintenance manuals for the step-by-step water treatment procedures, including procedures for testing the water quality.

### 1.3 GENERAL REQUIREMENTS

#### 1.3.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

#### 1.3.2 Asbestos Prohibition

Asbestos and asbestos-containing products shall not be used.

#### 1.3.3 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment. Each pressure vessel shall have an approved ASME stamp.

#### 1.3.4 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified. Catwalks, operating platforms, ladders, and guardrails shall be provided where shown and shall be constructed in accordance with Section 05502 METALS: MISCELLANEOUS, STANDARD ARTICLES, SHOP FABRICATED ITEMS.

#### 1.3.5 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work or ordering any materials.

#### 1.3.6 Welding

Boilers and piping shall be welded and brazed in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

#### 1.3.7 Spare Parts

The Contractor shall submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and no later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

### 1.4 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installing, adjusting, and testing of the equipment.

### 1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

## PART 2 PRODUCTS

### 2.1 BOILERS

Each boiler shall have the output capacity in kilowatts (kW) as indicated when fired with the specified fuels. The boiler shall be furnished

complete with the gas burning equipment, boiler fittings and trim, automatic controls, forced or induced draft fan, electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at the manufacturer's plant. Boiler auxiliaries including fans, motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with ASME BPVC SEC IV. Each boiler shall be of the cast iron type and designed for water service as specified herein. The boiler capacity shall be based on the ratings shown in HYI-005 or as certified by the American Boiler Manufacturers Association, or American Gas Association.

#### 2.1.1 Cast Iron Boiler

Boiler shall be of the rectangular, sectional type, self-contained, packaged type, complete with accessories, mounted on a structural steel base. Cast iron sections shall be free of leaks under all operating conditions. Access shall be provided to permit cleaning of internal tube surfaces.

#### 2.1.2 Hot Water Heating Boilers

The hot water heating boiler shall be capable of operating at the specified maximum continuous capacity without damage or deterioration to the boiler, its setting, firing equipment, or auxiliaries. The rated capacity shall be the capacity at which the boiler will operate continuously while maintaining at least the specified minimum efficiency. The boiler design conditions shall be as scheduled on drawings.

### 2.2 FUEL BURNING EQUIPMENT

Boiler shall be designed to burn gas. Each boiler shall comply with Federal, state, and local emission regulations.

#### 2.2.1 Burners

##### 2.2.1.1 Gas Fired Burners and Controls

Burners shall be UL approved mechanical draft burners with all air necessary for combustion supplied by a blower where the operation is coordinated with the burner or natural draft/atmospheric burners. Burner shall be provided complete with fuel supply system in conformance with the following safety codes or standards:

- a. Gas-fired units with inputs greater than 0.117 MW per combustion chamber shall conform to UL 795. Gas fired units less than 3.66 MW input shall conform to ANSI Z21.13. Single and multiple burner gas-fired units greater than or equal to 3.66 MW input shall conform to NFPA 85.

#### 2.2.2 Draft Fans

Fans conforming to AMCA 801 forced-draft shall be furnished as an integral part of boiler design. Fans shall be centrifugal with backward-curved

blades, radial-tip blades or axial flow type. Each fan shall be sized for output volume and static pressure rating sufficient for pressure losses, excess air requirements at the burner, leakages, temperature, and elevation corrections for worst ambient conditions, all at full combustion to meet net-rated output at normal firing conditions, plus an overall excess air volume of 10 percent against a 20 percent static overpressure. Noise levels for fans shall not exceed 85 decibels in any octave band at a 0.914 m station. Forced draft fan bearings shall be air cooled.

#### 2.2.2.1 Draft Fan Control

Forced-draft centrifugal fans shall have inlet vane controls or shall have variable speed control where indicated. Inlet vanes shall be suitable for use with combustion control equipment. Axial propeller fans shall have variable propeller pitch control.

#### 2.2.2.2 Draft Fan Drives

Fans shall be driven by electric motors. Electric motor shall be drip proof. Motor starter shall be magnetic across-the-line reduced voltage start type with general purpose weather-resistant watertight dust-tight enclosure and shall be furnished with four auxiliary interlock contacts.

#### 2.2.3 Draft Damper

Boilers shall be provided with automatic dampers, draft hoods, or barometric dampers as recommended by the boiler manufacturer to maintain proper draft in the boiler. Draft damper shall be provided in a convenient and accessible location in the flue gas outlet from the boiler. Automatic damper shall be arranged for automatic operation by means of a damper motor.

#### 2.2.4 Ductwork

Air ducts connecting the forced-draft fan units with the plenum chamber shall be designed to convey air with a minimum of pressure loss due to friction. Ductwork shall be galvanized sheet metal conforming to ASTM A 653/A 653M. Ducts shall be straight and smooth on the inside with laps made in direction of air flow. Ducts shall have cross-break with enough center height to assure rigidity in the duct section, shall be angle iron braced, and shall be completely free of vibration. Access and inspection doors shall be provided as indicated and required, with a minimum of one in each section between dampers or items of equipment. Ducts shall be constructed with long radius elbows having a centerline radius 1-1/2 times the duct width, or where the space does not permit the use of long radius elbows, short radius or square elbows with factory-fabricated turning vanes may be used. Duct joints shall be substantially airtight and shall have adequate strength for the service, with 38 x 38 x 3 mm angles used where required for strength or rigidity. Duct wall thickness shall be 16 gauge (1.5 mm) for ducts 1500 mm or less and 12 gauge (2.66 mm) for ducts larger than 1500 mm in maximum dimension. Additional ductwork shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

### 2.3 COMBUSTION CONTROL EQUIPMENT

Combustion control equipment shall be provided as a system by a single manufacturer. Field installed automatic combustion control system shall be installed in accordance with the manufacturer's recommendations and under the direct supervision of a representative of the control manufacturer. The

boiler water temperature shall be controlled by a water temperature controller. The equipment shall operate electrically. On multiple boiler installations, each boiler unit shall have a completely independent system of controls responding to the load and to a plant master controller. If recording instruments are provided, a 1 year supply of ink and 400 blank charts for each recorder shall be furnished.

#### 2.3.1 Electrical controls

Electrical control devices shall be rated at 120 or 24 volts and shall be connected as specified in Section 16402 INTERIOR DISTRIBUTION SYSTEM.

#### 2.3.2 Water Temperature Controller

The controller shall be of sturdy construction and shall be protected against dust and dampness. The thermostatic element shall be inserted in a separable socket installed in the upper part of the boiler near the water outlet or the boiler return piping. Fixed position (on-off) and three position (high-low-off) controller shall operate on a 5.56 degree C differential over an adjustable temperature range of approximately 60 to 104.4 degrees C. Modulating controllers shall control the fuel burning equipment to maintain set boiler water temperature within 2 percent. Controller shall be furnished with necessary equipment to automatically adjust the setting to suit the outside weather conditions. The outside air reset controller shall be operated in such a manner that the operating temperatures required by the boiler manufacturer are not compromised.

#### 2.3.3 Boiler Combustion Controls and Positioners

- a. Gas boiler units shall be provided with fixed rate (on-off) combustion controls with gas pilot or spark ignition.

#### 2.3.4 Combustion Safety Controls and Equipment

Combustion safety controls and equipment shall be UL listed, microprocessor-based distributed process controller. The system shall include mounting hardware, wiring and cables, and associated equipment. The controller shall be mounted completely wired, programmed, debugged, and tested to perform all of its functions. The controller shall process the signals for complete control and monitoring of the boiler. This shall include maintaining boiler status, starting and stopping all control functions, sequencing control functions and signaling alarm conditions. The program shall be documented and include cross references in description of coils and contacts. Microprocessor shall be able to perform self diagnostics and contain a message center to provide operator with status and failure mode information. Controllers for each boiler shall be mounted on a separate, free standing panel adjacent to the boiler or for packaged boilers on the boiler supporting structure. Control systems and safety devices for automatically fired boilers shall conform to ASME CSD-1. Electrical combustion and safety controls shall be rated at 120 volts, single phase, 60 Hz and shall be connected as specified in Section 16402 INTERIOR DISTRIBUTION SYSTEM. A 100 mm diameter alarm bell shall be provided and shall be located where indicated or directed. The alarm bell shall ring when the boiler is shut down by any safety control or interlock.

Indicating lights shall be provided on the control panel. A red light shall indicate flame failure, and a green light shall indicate that the main fuel valve is open. The following shutdown conditions shall require a manual reset before the boiler can automatically recycle:

- a. Flame failure.
- b. Failure to establish pilot flame.
- c. Failure to establish main flame.
- d. Low-water and supplementary low-water cutoff.
- e. High temperature cutoff and High pressure cutoff.

#### 2.3.4.1 Low-water Cutoff

Low water cutoff shall be float actuated switch or electrically actuated probe type low-water cutoff. Float chamber shall be provided with a blow-down connection. Cutoff shall cause a safety shutdown and sound an alarm when the boiler water level drops below a safe minimum level. A safety shutdown due to low water shall require manual reset before operation can be resumed and shall prevent recycling of the burner. The cutoff shall be in strict accordance to the latest version of code, ASME CSD-1 Controls and Safety Devices for Automatically Fired Boilers.

#### 2.3.4.2 Water Flow Interlock

Hot water boiler limit controls shall be provided to include protection for low boiler water flow and high boiler water temperature. The limit controls shall be interlocked with the combustion control system to effect boiler alarm and shutdown. The controls shall not allow boiler startup unless hot water flow is proven.

### 2.4 PUMPS

#### 2.4.1 Hot Water and Boiler Circulating Pumps

Circulating pumps for hot water shall be electrically driven single-stage centrifugal type and have a capacity not less than indicated. Boiler circulating pumps shall be supported on a concrete foundation with a cast iron or structural steel base or by the piping on which installed and shall be closed-coupled shaft or flexible-coupled shaft. The boiler circulating pumps shall be in-line type. Hot water circulating pumps shall be supported on a concrete foundation with a cast iron or structural steel base or by the piping on which installed and shall have a closed-coupled shaft or flexible-coupled shaft. The hot water circulating pumps shall be end-suction base mounted type. The pump shaft shall be constructed of corrosion-resistant alloy steel, sleeve bearings and glands of bronze designed to accommodate a mechanical seal, and the housing of close-grained cast iron. Pump seals shall be capable of withstanding 115 degrees C temperature without external cooling. The motor shall have sufficient power for the service required, shall be of a type approved by the manufacturer of the pump, shall be suitable for the available electric service, and shall conform to the requirements of paragraph ELECTRICAL EQUIPMENT. Each pump suction and discharge connection shall be provided with a pressure gauge as specified. The boiler and hot water circulating pump discharge heater shall be provided with a flow switch or pressure switch. Flow switch unit shall be a self-contained swinging vane type to indicate fluid flow. Pressure switch unit shall be a self-contained snap action type to indicate fluid pressure. Switch shall be a SPDT with 120-volt, 15-ampere rating.

## 2.5 COLD WATER CONNECTIONS

Connections shall be provided which includes consecutively in line a strainer, backflow prevention device, and water pressure regulator in that order in the direction of the flow. The backflow prevention device shall be provided as indicated and in compliance with Section 15400A PLUMBING, GENERAL PURPOSE. Cold water fill connections shall be made to the water supply system as indicated. Necessary pipe, fittings, and valves required for water connections between the boiler and cold water main shall be provided as shown. The pressure regulating valve shall be of a type that will not stick or allow pressure to build up on the low side. The valve shall be set to maintain a terminal pressure of approximately, lately 35 kPa in excess of the static head on the system and shall operate within a 15 kPa tolerance regardless of cold water supply piping pressure and without objectionable noise under any condition of operation.

### A. Glycol Water Make up System:

1. Glycol Water storage tank: Self supporting or polyethylene, minimum 90 mil thickness, with removable cover or black steel with 90 mil polyethylene insert. Capacity shall be 213 L (55 gallons), with approximate diameter of 584 mm (23 inches) and height of 914 mm (36 inches). Reinforced threaded pipe connections shall be provided for all connections. Provide identification for tank showing name of the contents.

2. Glycol Water make up pump: Bronze fitted, self priming, high head type suitable for pumping a 33 percent to 50 percent glycol water solution in intermittent service. The pump shall be provided with a mechanical shaft seal and be flange connected to a 1750 rpm NEMA type C motor. The pump capacity shall be 6.81 L/m at 345 kPa discharge pressure with a suction lift capability of 127 mm (five inches) of mercury, with a .25 kW (1/3 horsepower) drip proof motor. The pump may be a "gear within a gear" positive displacement type with built in relief valve set for 296 kPa (43 psi), or the pump may be a regenerative turbine type providing self priming with built in or external relief valve set for design head of the pump.

3. Back pressure regulating valve: Spring loaded, diaphragm actuated type with bronze or steel body, stainless steel trim with capacity to relieve 100 percent of pump flow with an allowable rise in the regulated pressure of 69 kPa (10 psi) above the set point. Set point shall be 103 kPa (15 psi) above system PRV setting.

4. Low water level control: Steel or cast iron float housing, stainless steel float, positive snap acting SPST switch mechanism, rated 10 amps 120 volt AC, in General Purpose (NEMA 1) enclosure. The control shall be rated for pressures to 1034 kPa (150 psi) and make alarm circuit on low water level. The alarm circuit shall be wired to an alarm light on the nearest LTCP.

## 2.6 UNIT HEATERS

Heaters shall be as specified below, and shall have a heating capacity not in excess of 125 percent of the capacity indicated.

### 2.6.1 Propeller Fan Heaters

Heaters shall be designed for suspension and arranged for horizontal

discharge of air as indicated. Casings shall be not less than 0.912 mm (20 gauge) black steel and finished with lacquer or enamel. Suitable stationary or rotating air deflectors shall be provided to assure proper air and heat penetration capacity at floor level based on established design temperature. Suspension from heating pipes will not be permitted. Horizontal discharge type unit heaters shall have discharge or face velocities not in excess of the following:

Unit Capacity, Liters per Second	Face Velocity, Meters per Second
Up to 472 (1000)	4.06 (800)
473 (1001)	4.57 (900)
1417 (3001)	5.08 (1,000)

#### 2.6.2 Heating Elements

Heating coils and radiating fins shall be of suitable nonferrous alloy with threaded brazed fittings at each end for connecting to external piping. The heating elements shall be free to expand or contract without developing leaks and shall be properly pitched for drainage. The elements shall be tested under a hydrostatic pressure of 1.38 MPa and a certified report of the test shall be submitted to the Contracting Officer. Heating coils shall be as specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM for types indicated. Coils shall be suitable for use with water up to 121 degrees C.

#### 2.6.3 Motors

Motors shall be provided with NEMA 250 general purpose enclosure. Motors and motor controls shall otherwise be as specified in Section 16402 INTERIOR DISTRIBUTION SYSTEM.

#### 2.6.4 Motor Switches

Motors shall be provided with manual selection switches with "Off," and "Automatic" positions and shall be equipped with thermal overload protection.

#### 2.6.5 Controls

Controls shall be provided as specified in Section 15951 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS.

### 2.7 HEATING AND VENTILATING UNITS

Heating and ventilating units and associated equipment shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

### 2.8 AIR HANDLING UNITS

Air handling units and associated equipment shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

### 2.9 FITTINGS AND ACCESSORIES

Boiler fittings and accessories shall be installed with each boiler in

accordance with ASME BPVC SEC IV, unless otherwise specified.

#### 2.9.1 Carbon Monoxide Detector and Natural Gas Detector (For Vehicle Processing Area Room 107 and Mechanical Room 115)

##### 2.9.1.1 Carbon Monoxide Detector

The Contractor shall install a carbon monoxide detector at the high point within the mechanical room and as recommended by the manufacturer. Upon activation of the detector, a "alarm and trouble" signal shall be transmitted to the fire alarm system. The carbon monoxide detector shall be industrialized detector capable of operating in a high humidity (90% or less) atmosphere. The carbon monoxide detector shall be of the electro-chemical type with a field replaceable cell. The detector shall be capable of reporting a trouble or failure condition through the closure of a form "C" contacts. The detector shall be capable of reporting an excessive level of carbon monoxide gas factory set to those levels specified in UL 2034. The detector shall provide, at least, a digital readout of the alarm condition which will require manual cleaning of the device. Device shall be mounted in accordance with the manufacturer's recommendations. The Contractor shall provide calibration kits in sufficient quantity to calibrate all sensors regardless of whether sensors are factory of field calibrated. Should the Contractor field calibrate sensors, he shall provide his own supplies for the calibration separate from the required kits above. Detector shall be Scott Instruments Sentinel II Monitor, or approved equal by the Contracting Officer.

##### 2.9.1.2 Natural Gas Detector

The Contractor shall install a gas detector and a normally open solenoid valve in the incoming gas line at each mechanical room. The gas detector shall energize the solenoid valve to close when gas is detected and a "trouble" signal shall be transmitted through the fire alarm system transmitter. The solenoid valve shall have a manual reset. The gas detector shall be installed at the high point within the mechanical room. The solenoid valve shall be installed in the gas piping such that only the natural gas fired boilers and water heaters in the mechanical room are interrupted by the gas detector activation. The natural gas detector shall be an industrialized detector capable of operating in a high humidity (90% or less) atmosphere. The detector shall be capable of reporting a alarm or failure conditions through the closure of a form "C" contacts. The detector shall be capable of reporting at 20% LEL for natural gas and shall be factory set to those levels specified in UL 1484. The detector shall provide, at least, a digital readout of the alarm condition which will require manual cleaning of the device. Gas detector shall be stable with +/- 5% of its set point under all normal environmental conditions. Device shall be mounted in accordance with the manufacturer's recommendations. The Contractor shall provide calibration kits in sufficient quantity to calibrate all sensors regardless of whether sensors are factory or field calibrated. Should the Contractor field calibrate sensors, he shall provide his own supplies for the calibration separate from the required kits above. Sensors shall be calibrated by the factory or shall be field calibrated by the Contractor. Detector shall be Scott Instruments Sentinel II Monitor, or approved equal by the Contracting Officer.

##### 2.9.1.3 Connection to Fire Alarm System

Gas and carbon monoxide detectors shall be supplied with battery backup. Each detector shall be provided with built-in horn to sound an alarm at 85

dB at 10 feet.

#### 2.9.1.4 Power Connections

Power shall be provided through a hard wired connection to a lockable circuit breaker (in the on-position) dedicated for the unit.

#### 2.9.1.5 Control Systems Integration

The boiler controls shall be integrated with the Trane controls for supervisory and data acquisition through the Trane Tracer system.

All work shall meet the latest applicable requirements of the following:

- 1) International Building Code (IBC)
- 2) NFPA (National Fire Protection Association) Standards 80, 90A, 90B, 211, and 221
- 3) Life Safety Code (NFPA 101)
- 4) National Fuel Gas Code (NFPA 54)
- 5) National Electric Code (NFPA 70)
- 6) SMACNA (Sheet Metal and Air Conditioning Contractor's National Association) manuals and publications
- 7) ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers) handbooks and publications
- 8) ICC International Plumbing Code
- 9) UFC-3-600-01 Design: Fire Protection Engineering for Facilities
- 10) New York State Department of Health regulations
- 11) Other criteria required by the equipment manufacturers

#### 2.9.2 Conventional Breeching and Stacks

##### 2.9.2.1 Stacks

Prefabricated double wall stacks system shall extend 600 mm above the peak of the roof. The inner stack shall be 304 stainless steel or 316 stainless steel having a thickness of not less than 0.89 mm. The outer stack shall be sheet steel having a thickness of not less than 0.635 mm. A method of maintaining concentricity between the inner and outer stacks shall be incorporated. The joints between the stack sections shall be sealed to prevent flue gas leakage. A 7.92 mm diameter hole shall be provided in the stack not greater than 150 mm from the furnace flue outlet for sampling of the exit gases. A method shall be provided to seal the hole to prevent exhaust gases from entering the boiler room when samples are not being taken. Each stack shall be provided complete with rain hood. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

#### 2.9.3 Expansion Tank

The hot water pressurization system shall include a bladder-type expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the tank. The sizes shall be as indicated. The expansion tank shall be welded steel, constructed, tested, and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 862 kPa and precharged to the minimum operating pressure. The tank's air chamber shall be fitted with an air charging valve and pressure gauge.

The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The tank shall have lifting rings and a drain connection. All components shall be suitable for a maximum operating temperature of 120 degrees C.

#### 2.9.4 Air Separator

External air separation tank shall be steel, constructed, tested and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 862 kPa. The capacity of the air separation tank indicated is minimum.

#### 2.9.5 Filters

Filters shall conform to ASHRAE 52.1.

#### 2.9.6 Steel Sheets

##### 2.9.6.1 Galvanized Steel

Galvanized steel shall be ASTM A 653/A 653M.

##### 2.9.6.2 Uncoated Steel

Uncoated steel shall be composition, condition, and finish best suited to the intended use.

#### 2.9.7 Gaskets

Gaskets shall be nonasbestos material in accordance with ASME B16.20, full face or self-centering type. The gaskets shall be of the spiral wound type with graphite filler material.

#### 2.9.8 Steel Pipe and Fittings

##### 2.9.8.1 Steel Pipe

Steel pipe shall be ASTM A 53/A 53M, Type E or S, Grade A or B, black steel, standard weight.

##### 2.9.8.2 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

##### 2.9.8.3 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturers trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

##### 2.9.8.4 Welded Fittings

Welded fittings shall conform to ASTM A 234/A 234M with WPA marking. Buttwelded fittings shall conform to ASME B16.9, and socket-welded fittings shall conform to ASME B16.11.

#### 2.9.8.5 Cast-Iron Fittings

Fittings shall be ASME B16.4, Class 125, type required to match connecting piping.

#### 2.9.8.6 Malleable-Iron Fittings

Fittings shall be ASME B16.3, type as required to match connecting piping.

#### 2.9.8.7 Unions

Unions shall be ASME B16.39, Class 150.

#### 2.9.8.8 Threads

Pipe threads shall conform to ASME B1.20.1.

#### 2.9.8.9 Grooved Mechanical fittings

Joints and fittings shall be designed for not less than 862 kPa service and shall be the product of the same manufacturer. Fitting and coupling houses shall be ductile iron conforming to ASTM A 536. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 for circulating medium up to 110 degrees C. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

#### 2.9.9 Copper Tubing and Fittings

##### 2.9.9.1 Copper Tubing

Tubing shall be ASTM B 88, ASTM B 88M, Type K or L. Adapters for copper tubing shall be brass or bronze for brazed fittings.

##### 2.9.9.2 Solder-Joint Pressure Fittings

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and ASTM B 828.

##### 2.9.9.3 Flared Fittings

Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62.

##### 2.9.9.4 Adapters

Adapters may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

##### 2.9.9.5 Threaded Fittings

Cast bronze threaded fittings shall conform to ASME B16.15.

#### 2.9.9.6 Brazing Material

Brazing material shall conform to AWS A5.8.

#### 2.9.9.7 Brazing Flux

Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides, and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.

#### 2.9.9.8 Solder Material

Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

#### 2.9.9.9 Solder Flux

Flux shall be either liquid or paste form, non-corrosive and conform to ASTM B 813.

#### 2.9.9.10 Grooved Mechanical Fittings

Joints and fittings shall be designed for not less than 862 kPa coupling houses shall be ductile iron conforming to ASTM A 536. Gaskets shall be molded synthetic rubber with central cavity, pressure responsible configuration and shall conform to ASTM D 2000, for circulating medium up to 110 degrees C. Grooved mechanical fittings shall not be used for hot water piping, steam piping or condensate piping above 110 degrees C. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

#### 2.9.10 Dielectric Waterways and Flanges

Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

#### 2.9.11 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 861.8 kPa or 1034.2 kPa service. Connectors shall be installed where indicated. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, and temperature medium. The flexible section shall be suitable for service intended and may have threaded, welded, soldered, flanged, or socket ends. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

## 2.9.12 Pipe Supports

Pipe supports shall conform to MSS SP-58 and MSS SP-69.

## 2.9.13 Pipe Expansion

### 2.9.13.1 Expansion Loops

Expansion loops and offsets shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1.

The loops and offsets shall be cold-sprung and installed where indicated, or required. Pipe guides and anchors shall be provided as indicated.

## 2.9.14 Valves

Valves shall be Class 125 and shall be suitable for the application. Grooved ends per AWWA C606 may be used for water service only. Valves in nonboiler external piping shall meet the material, fabrication and operating requirements of ASME B31.1. The connection type of all valves shall match the same type of connection required for the piping on which installed.

### 2.9.14.1 Gate Valves

Gate valves 65 mm and smaller shall conform to MSS SP-80 bronze rising stem, threaded, solder, or flanged ends. Gate valves 80 mm and larger shall conform to MSS SP-70 cast iron bronze trim, outside screw and yoke, flanged, or threaded ends.

### 2.9.14.2 Globe Valves

Globe valves 65 mm and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 80 mm and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

### 2.9.14.3 Check Valves

Check valves 65 mm and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Check valves 80 mm and larger shall conform to MSS SP-71, cast iron, bronze trim, flanged, or threaded ends.

### 2.9.14.4 Angle Valves

Angle valves 65 mm and smaller shall conform to MSS SP-80 bronze, threaded, soldered, or flanged ends. Angle valves 80 mm and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

### 2.9.14.5 Ball Valves

Ball valves 15 mm and larger shall conform to MSS SP-72 or MSS SP-110, ductile iron or bronze, threaded, soldered, or flanged ends.

### 2.9.14.6 Grooved End Valves

Valves with grooved ends per AWWA C606 may be used if the valve manufacturer certifies that their performance meets the requirements of the standards indicated for each type of valve.

#### 2.9.14.7 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves.

An integral pointer shall register the degree of valve opening. Valves shall be calibrated so that flow rate can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 120 degrees C temperature and working pressure of the pipe in which installed.

Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves, and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

#### 2.9.14.8 Automatic Flow Control Valves

In lieu of the specified balancing valves, automatic flow control valves may be provided to maintain constant flow and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 862 kPa or 150 percent of the system operating pressure, whichever is greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be increased. Valves shall be suitable for 120 degrees C temperature service. Valve materials shall be same as specified for the heating system check, globe, angle, and gate valves. Valve operator shall be the electric motor type or pneumatic type as applicable. Valve operator shall be capable of positive shutoff against the system pump head. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter shall be provided with accessory kit as recommended for the project by the automatic valve manufacturer.

#### 2.9.14.9 Butterfly Valves

Butterfly valves shall be 2-flange type or lug wafer type, and shall be bubbletight at 1135 kPa. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze, or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 200 mm shall have throttling handles with a minimum of seven locking positions. Valves 200 mm and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

#### 2.9.14.10 Drain valves

Drain valves shall be provided at each drain point of blowdown as

recommended by the boiler manufacturer. Piping shall conform to ASME BPVC SEC IV and ASTM A 53/A 53M.

#### 2.9.14.11 Safety Valves

Safety valves shall have steel bodies and shall be equipped with corrosion-resistant trim and valve seats. The valves shall be properly guided and shall be positive closing so that no leakage can occur. Adjustment of the desired back-pressure shall cover the range between 15 and 70 kPa. The adjustment shall be made externally, and any shafts extending through the valve body shall be provided with adjustable stuffing boxes having renewable packing. Boiler safety valves of proper size and of the required number, in accordance with ASME BPVC SEC IV, shall be installed so that the discharge will be through piping extended to a location as indicated. Each discharge pipe for hot water service shall be pitched away from the valve seat.

#### 2.9.15 Strainers

Basket and "Y" type strainers shall be the same size as the pipelines in which they are installed. The strainer bodies shall be heavy and durable, fabricated of cast iron, and shall have bottoms drilled and tapped with a gate valve attached for blowdown purposes. Strainers shall be designed for 862 kPa service or 150% of the maximum operating pressure of the piping system in which they are installed, whichever is greater, and 100 degrees C. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment screen. The screen shall be made of 0.795 mm thick brass sheet or monel, or corrosion-resistant steel with small perforations numbering not less than 620,000 per square m to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

#### 2.9.16 Pressure Gauges

Gauges shall conform to ASME B40.100 and shall be provided with throttling type needle valve or a pulsation dampener and shutoff valve. Minimum dial size shall be 90 mm. A pressure gauge shall be provided for each boiler in a visible location on the boiler. Pressure gauges shall be provided with readings in Kpa and psi. Pressure gauges shall have an indicating pressure range that is related to the operating pressure of the fluid in accordance with the following table:

Operating Pressure (kPA)	Pressure Range (kPA)
519-1030	0-1400
105-518	0-690
14-104	0-210 (retard)
Operating Pressure (psi)	Pressure Range (psi)
76-150	0-200
16-75	0-100
2-15	0-30 (retard)

#### 2.9.17 Thermometers

Thermometers shall be provided with wells and separable corrosion-resistant

steel sockets. Mercury shall not be used in thermometers. Thermometers for inlet water and outlet water for each hot water boiler shall be provided in a visible location on the boiler. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a minimum 225 mm scale. The operating range of the thermometers shall be 0-100 degrees C. The thermometers shall be provided with readings in degrees C and F.

## 2.9.18 Air Vents

### 2.9.18.1 Manual Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for the pressure rating of the piping system and furnished with threaded plugs or caps.

### 2.9.18.2 Automatic Air Vents

Automatic air vents shall be 20 mm quick-venting float and vacuum air valves. Each air vent valve shall have a large port permitting the expulsion of the air without developing excessive back pressure, a noncollapsible metal float which will close the valve and prevent the loss of water from the system, an air seal that will effectively close and prevent the re-entry of air into the system when subatmospheric pressures prevail therein, and a thermostatic member that will close the port against the passage of steam from the system. The name of the manufacturer shall be clearly stamped on the outside of each valve. The air vent valve shall be suitable for the pressure rating of the piping system.

## 2.10 ELECTRICAL EQUIPMENT

Electric motor-driven equipment shall be provided complete with motors, motor starters, and necessary control devices. Electrical equipment, motor control devices, motor efficiencies and wiring shall be as specified in Section 16402 INTERIOR DISTRIBUTION SYSTEM. Motors which are not an integral part of a packaged boiler shall be rated for high efficiency service. Motors which are an integral part of the packaged boiler shall be the highest efficiency available by the manufacturer of the packaged boiler. Motor starters shall be provided complete with properly sized thermal overload protections and other appurtenances necessary for the motor control specified. Starters shall be furnished in general purpose enclosures. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices but not shown shall be provided.

### 2.10.1 Motor Ratings

Motors shall be suitable for the voltage and frequency provided. Motors 375 W (1/2 hp) and larger shall be three-phase, unless otherwise indicated. Motors shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating on the motor.

### 2.10.2 Motor Controls

Motor controllers shall be provided complete with properly sized thermal overload protection. Manual or automatic control and protective or signal devices required for the operation specified and any wiring required to such devices shall be provided. Where two-speed or variable-speed motors

are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Solid state variable speed controllers shall be utilized for fractional through 7.46 kW (10 hp) ratings. Adjustable frequency drives shall be used for larger motors.

## 2.11 INSULATION

Shop and field-applied insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

## 2.12 TOOLS

Special tools shall be furnished. Special tools shall include uncommon tools necessary for the operation and maintenance of boilers, burners, pumps, fans, controls, meters, special piping systems, and other equipment. Small hand tools shall be furnished within a suitable cabinet, mounted where directed.

### 2.12.1 Breeching Cleaner

A cleaner shall be provided to clean the breeching. The cleaner shall have a jointed handle of sufficient length to clean the breeching without dismantling.

### 2.12.2 Wrenches

Wrenches shall be provided as required for specialty fittings such as manholes, handholes, and cleanouts. One set of extra gaskets shall be provided for all manholes and handholes, for pump barrels, and other similar items of equipment. Gaskets shall be packaged and properly identified.

## 2.13 BOILER WATER TREATMENT

A 50 percent concentration by volume of industrial grade propylene glycol shall be provided. The propylene glycol shall be tested in accordance with ASTM D 1384 with less than 0.013 mm (0.5 mils) penetration per year for all system metals. The propylene glycol shall contain corrosion inhibitors. Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and water treatment chemicals used within the system. The water shall be treated to maintain the conditions recommended by the boiler manufacturer. Chemicals shall meet required federal, state, and local environmental regulations for the treatment of boilers and discharge to the sanitary sewer. The services of a company regularly engaged in the treatment of boilers shall be used to determine the correct chemicals and concentrations required for water treatment. The company shall maintain the chemical treatment and provide all chemicals required for a period of 1 year from the date of occupancy. Filming amines and proprietary chemicals shall not be used. The water treatment chemicals shall remain stable throughout the operating temperature range of the system and shall be compatible with pump seals and other elements of the system.

### 2.13.1 Boiler Water Limits

The boiler manufacturer shall be consulted for the determination of the boiler water chemical composition limits. The boiler water limits shall be as follows unless dictated differently by the boiler manufacturer's recommendations:

Causticity	20-200 ppm
Total Alkalinity (CACO3)	900-1200 ppm
Phosphate	30-60 ppm
Tanin	Medium
Dissolved Solids	3000-5000 ppm
Suspended Solids	300 ppm Max
Sodium Sulfite	20-40 ppm Max
Silica	Less than 150 ppm
Dissolved Oxygen	Less than 7 ppm
Iron	10 ppm
pH (Condensate)	7 - 8
Sodium Sulfite	20-40 ppm
Hardness	Less than 2 ppm
pH	9.3 - 9.9

### PART 3 EXECUTION

#### 3.1 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

Boiler and auxiliary equipment shall be installed in accordance with manufacturer's written instructions. Proper provision shall be made for expansion and contraction between boiler foundation and floor. This joint shall be packed with suitable nonasbestos rope and filled with suitable compound that will not become soft at a temperature of 40 degrees C. Boilers and firing equipment shall be supported from the foundations by structural steel completely independent of all brickwork. Boiler supports shall permit free expansion and contraction of each portion of the boiler without placing undue stress on any part of the boiler or setting. Boiler breeching shall be as indicated with full provision for expansion and contraction between all interconnected components.

#### 3.2 PIPING INSTALLATION

Unless otherwise specified, nonboiler external pipe and fittings shall conform to the requirements of ASME B31.1. Pipe installed shall be cut accurately to suit field conditions, shall be installed without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Pipes shall be free of burrs, oil, grease and other foreign material and shall be installed to permit free expansion and contraction without damaging the building structure, pipe, pipe joints, or pipe supports. Changes in direction shall be made with fittings, except that bending of pipe 100 mm and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be carried through the roof as directed and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 0.2 percent. Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unless otherwise specified or shown, final connections to equipment shall be made with malleable-iron unions for steel pipe 65 mm or less in diameter and with flanges for pipe 80 mm or more in diameter. Unions for copper pipe or tubing shall be brass or bronze. Reducing fittings shall be used for changes in pipe sizes. In horizontal hot water lines, reducing fittings shall be eccentric type to maintain the top of the

lines at the same level to prevent air binding.

### 3.2.1 Hot Water Piping and Fittings

Pipe shall be black steel or copper tubing. Fittings for steel piping shall be black malleable iron or cast iron to suit piping. Fittings adjacent to valves shall suit valve material. Grooved mechanical fittings will not be allowed for water temperatures above 110 degrees C.

### 3.2.2 Vent Piping and Fittings

Vent piping shall be black steel. Fittings shall be black malleable iron or cast iron to suit piping.

### 3.2.3 Gauge Piping

Piping shall be copper tubing.

### 3.2.4 Joints

Joints between sections of steel pipe and between steel pipe and fittings shall be threaded, grooved, flanged or welded as indicated or specified. Except as otherwise specified, fittings 25 mm and smaller shall be threaded; fittings 32 mm and up to but not including 80 mm shall be either threaded, grooved, or welded; and fittings 80 mm and larger shall be either flanged, grooved, or welded. Pipe and fittings 32 mm and larger installed in inaccessible conduit or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 65 mm or smaller in diameter and with flanges for pipe 80 mm inches or larger in diameter. Joints between sections of copper tubing or pipe shall be flared, soldered, or brazed.

#### 3.2.4.1 Threaded Joints

Threaded joints shall be made with tapered threads properly cut and shall be made perfectly tight with a stiff mixture of graphite and oil or with polytetrafluoroethylene tape applied to the male threads only and in no case to the fittings.

#### 3.2.4.2 Welded Joints

Welded joints shall be in accordance with paragraph GENERAL REQUIREMENTS unless otherwise specified. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow characteristics where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1.5 mm and no more than 3 mm.

#### 3.2.4.3 Grooved Mechanical Joints

Grooved mechanical joints may be provided for hot water systems in lieu of unions, welded, flanged, or screwed piping connections in low temperature hot water systems where the temperature of the circulating medium does not

exceed 110 degrees C. Grooves shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations. Mechanical joints shall use rigid mechanical pipe couplings, except at equipment connections. At equipment connections, flexible couplings may be used. Coupling shall be of the bolted type for use with grooved end pipes, fittings, valves, and strainers. Couplings shall be self-centering and shall engage in a watertight couple.

#### 3.2.4.4 Flared and Brazed Copper Pipe and Tubing

Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA A4015 with flux. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver or a silver brazing filler metal. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided in all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Flared or brazed copper tubing to pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing.

#### 3.2.4.5 Soldered Joints

Soldered joints shall be made with flux and are only acceptable for lines 50 mm and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015.

#### 3.2.4.6 Copper Tube Extracted Joint

An extruded mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

#### 3.2.5 Flanges and Unions

Flanges shall be faced true, provided with 1.6 mm thick gaskets, and made square and tight. Where steel flanges mate with cast-iron flanged

fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Dielectric pipe unions shall be provided between ferrous and nonferrous piping to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

### 3.2.6 Branch Connections

#### 3.2.6.1 Branch Connections for Hot Water Systems

Branches from the main shall pitch up or down as shown to prevent air entrapment. Connections shall ensure unrestricted circulation, eliminate air pockets, and permit complete drainage of the system. Branches shall pitch with a grade of not less than 8 mm in 1 m. When indicated, special flow fittings shall be installed on the mains to bypass portions of the water through each radiator. Special flow fittings shall be standard catalog products and shall be installed as recommended by the manufacturer.

#### 3.2.7 Flared, Brazed, and Soldered Copper Pipe and Tubing

Copper tubing shall be flared, brazed, or soldered. Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing. Brazed joints shall be made in conformance with MSS SP-73, and CDA A4015. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver, or a silver brazing filler metal. Soldered joints shall be made with flux and are only acceptable for lines 50 mm or smaller. Soldered joints shall conform to ASME B31.5 and shall be in accordance with CDA A4015.

#### 3.2.8 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

### 3.2.9 Supports

Hangers used to support piping 50 mm and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. Threaded rods which are used for support shall not be formed or bent. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer.

#### 3.2.9.1 Seismic Requirements for Supports and Structural Bracing

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided in this section. Material used for supports shall be as specified in Section 05120 STRUCTURAL STEEL.

#### 3.2.9.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe, if the clamp bottom does not extend through the insulation, and if the top clamp attachment does not contact the insulation during pipe movement.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices furnished by the manufacturer. Field fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1500 mm apart at valves.
- h. Vertical pipe shall be supported at each floor, except at

slab-on-grade, and at intervals of not more than 4500 mm, not more than 2400 mm from end of risers, and at vent terminations.

- i. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.
  - (1) Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 100 mm and larger, a Type 39 saddle may be welded to the pipe and freely rested on a steel plate. On piping under 100 mm, a Type 40 protection shield may be attached to the pipe or insulation and freely rested on a steel slide plate.
  - (2) Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm or by an amount adequate for the insulation, whichever is greater.
- j. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.
- k. Piping in trenches shall be supported as indicated.
- l. Structural steel attachments and brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section 05120 STRUCTURAL STEEL. Pipe hanger loads suspended from steel joist between panel points shall not exceed 22 kg. Loads exceeding 22 kg shall be suspended from panel points.

#### 3.2.9.3 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support member shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run. The clips or clamps shall be rigidly attached to the common base member. A clearance of 3 mm shall be provided between the pipe insulation and the clip or clamp for piping which may be subjected to thermal expansion.

#### 3.2.10 Anchors

Anchors shall be provided where necessary to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

### 3.2.11 Valves

Valves shall be installed where indicated, specified, and required for functioning and servicing of the systems. Valves shall be safely accessible. Swing check valves shall be installed upright in horizontal lines and in vertical lines only when flow is in the upward direction. Gate and globe valves shall be installed with stems horizontal or above. Valves to be brazed shall be disassembled prior to brazing and all packing removed. After brazing, the valves shall be allowed to cool before reassembling.

### 3.2.12 Pipe Sleeves

Pipe passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. A waterproofing clamping flange shall be installed as indicated where membranes are involved. Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof. Sleeves through walls shall be cut flush with wall surface. Sleeves through floors shall be cut flush with floor surface or extend above top surface of floor a sufficient distance to allow for proper flashing or finishing. Sleeves through roofs shall extend above the top surface of roof at least 150 mm for proper flashing or finishing. Unless otherwise indicated, sleeves shall be sized to provide a minimum clearance of 6 mm between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in waterproofing membrane floors, bearing walls, and wet areas shall be galvanized steel pipe or cast-iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be galvanized steel pipe, cast-iron pipe, or galvanized sheet metal with lock-type longitudinal seam. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls shall be sealed as indicated and specified in Section 07920 JOINT SEALANTS. Metal jackets shall be provided over insulation passing through exterior walls, firewalls, fire partitions, floors, or roofs.

- a. Metal jackets shall not be thinner than 0.1524 mm thick aluminum, if corrugated, and 0.4 mm thick aluminum, if smooth.
- b. Metal jackets shall be secured with aluminum or stainless steel bands not less than 9 mm wide and not more than 200 mm apart. When penetrating roofs and before fitting the metal jacket into place, a 15 mm wide strip of sealant shall be run vertically along the inside of the longitudinal joint of the metal jacket from a point below the backup material to a minimum height of 1000 mm above the roof. If the pipe turns from vertical to horizontal, the sealant strip shall be run to a point just beyond the first elbow. When penetrating waterproofing membrane for floors, the metal jacket shall extend from a point below the back-up material to a minimum distance of 50 mm above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 300 mm above material to a minimum distance of 50 mm above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 300 mm above the floor; when passing through walls above grade, the jacket shall extend at least 100 mm beyond each side of the wall.

### 3.2.12.1 Pipes Passing Through Waterproofing Membranes

In addition to the pipe sleeves referred to above, pipes passing through waterproofing membranes shall be provided with a 1.6 mm lead flashing or a 0.55 mm copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm from the pipe and shall set over the membrane in a troweled coating of bituminous cement. The flashing shall extend above the roof or floor a minimum of 250 mm. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Pipes up to and including 250 mm in diameter which pass through waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

### 3.2.12.2 Optional Modular Mechanical Sealing Assembly

At the option of the Contractor, a modular mechanical type sealing assembly may be installed in the annular space between the sleeve and conduit or pipe in lieu of a waterproofing clamping flange and caulking and sealing specified above. The seals shall include interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

### 3.2.12.3 Optional Counterflashing

As alternates to caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may consist of standard roof coupling for threaded pipe up to 150 mm in diameter, lead flashing sleeve for dry vents with the sleeve turned down into the pipe to form a waterproof joint, or a tack-welded or banded-metal rain shield around the pipe, sealed as indicated.

### 3.2.12.4 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

### 3.2.13 Balancing Valves

Balancing valves shall be installed as indicated.

### 3.2.14 Thermometer Wells

A thermometer well shall be provided in each return line for each circuit in multicircuit systems.

### 3.2.15 Air Vents

Air vents shall be installed where shown or directed. Air vents shall be installed in piping at all system high points. The vent shall remain open

until water rises in the tank or pipe to a predetermined level at which time it shall close tight. An overflow pipe from the vent shall be run to a point designated by the Contracting Officer's representative. The inlet to the air vent shall have a gate valve or ball valve.

#### 3.2.16 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrews.

#### 3.2.17 Drains

A drain connection with a 25 mm gate valve or 20 mm hose bib shall be installed at the lowest point in the return main near the boiler. In addition, threaded drain connections with threaded cap or plug shall be installed on the heat exchanger coil on each unit heater or unit ventilator and wherever required for thorough draining of the system.

#### 3.2.18 Strainer Blow-Down Piping

Strainer blow-down connections shall be fitted with a black steel blow-down pipeline routed to an accessible location and provided with a blow-down valve.

### 3.3 GAS FUEL SYSTEM

Gas piping, fittings, valves, regulators, tests, cleaning, and adjustments shall be in accordance with the Section 15190A GAS PIPING SYSTEMS. NFPA 54 shall be complied with unless otherwise specified. Burners, pilots, and all accessories shall be listed in UL Gas&Oil Dir. The fuel system shall be provided with a gas tight, manually operated, UL listed stop valve at the gas-supply connections, a gas strainer, a pressure regulator, pressure gauges, a burner-control valve, a safety shutoff valve suitable for size of burner and sequence of operation, and other components required for safe, efficient, and reliable operation as specified. Approved permanent and ready facilities to permit periodic valve leakage tests on the safety shutoff valve or valves shall be provided.

### 3.4 COLOR CODE MARKING AND FIELD PAINTING

Color code marking of piping shall be as specified in Section 09900 PAINTS AND COATINGS. Ferrous metal not specified to be coated at the factory shall be cleaned, prepared, and painted as specified in Section 09900 PAINTS AND COATINGS. Exposed pipe covering shall be painted as specified in Section 09900 PAINTS AND COATINGS. Aluminum sheath over insulation shall not be painted.

### 3.5 TEST OF BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assemblies shall be tested in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

### 3.6 HEATING SYSTEM TESTS

The Contractor shall submit the Qualifications of the firms in charge of

installation and testing as specified in the Submittals paragraph. Before any covering is installed on pipe or heating equipment, the entire heating system's piping, fittings, and terminal heating units shall be hydrostatically tested and proved tight at a pressure of 1-1/2 times the design working pressure, but not less than 689 kPa. Before pressurizing system for test, items or equipment (e.g., vessels, pumps, instruments, controls, relief valves) rated for pressures below the test pressure shall be blanked off or replaced with spool pieces. Before balancing and final operating test, test blanks and spool pieces shall be removed; and protected instruments and equipment shall be reconnected. With equipment items protected, the system shall be pressurized to test pressure. Pressure shall be held for a period of time sufficient to inspect all welds, joints, and connections for leaks, but not less than 2 hours. No loss of pressure will be allowed. Leaks shall be repaired and repaired joints shall be retested. Repair joints shall not be allowed under the floor for floor radiant heating systems. If a leak occurs in tubing located under the floor in radiant heating systems, the entire zone that is leaking shall be replaced. If any repair is made above the floor for floor radiant heating systems, access shall be provided for the installed joint. Caulking of joints shall not be permitted. System shall be drained and after instruments and equipment are reconnected, the system shall be refilled with service medium and maximum operating pressure applied. The pressure shall be held while inspecting these joints and connections for leaks. The leaks shall be repaired and the repaired joints retested. Upon completion of hydrostatic tests and before acceptance of the installation, the Contractor shall balance the heating system in accordance with Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS; and operating tests required to demonstrate satisfactory functional and operational efficiency shall be performed. The operating test shall cover a period of at least 24 hours for each system, and shall include, as a minimum, the following specific information in a report, together with conclusions as to the adequacy of the system:

- a. Certification of balancing.
- b. Time, date, and duration of test.
- c. Outside and inside dry bulb temperatures.
- d. Temperature of hot water supply leaving boiler.
- e. Temperature of [heating return water from system at+ boiler inlet.
- f. Quantity of water feed to boiler.
- g. Boiler make, type, serial number, design pressure, and rated capacity.
- h. Fuel burner make, model, and rated capacity; ammeter and voltmeter readings for burner motor.
- i. Circulating pump make, model, and rated capacity, and ammeter and voltmeter readings for pump motor during operation.
- j. Flue-gas temperature at boiler outlet.
- k. Percent carbon dioxide in flue-gas.
- l. Grade or type and calorific value of fuel.

- m. Draft at boiler flue-gas exit.
- n. Draft or pressure in furnace.
- o. Quantity of water circulated.
- p. Quantity of fuel consumed.
- q. Stack emission pollutants concentration.

Indicating instruments shall be read at half-hour intervals unless otherwise directed. The Contractor shall furnish all instruments, equipment, and personnel required for the tests and balancing. Fuels, water, and electricity shall be obtained as specified in the SPECIAL CONTRACT REQUIREMENTS. Operating tests shall demonstrate that fuel burners and combustion and safety controls meet the requirements of ASME CSD-1, ANSI Z21.13 and NFPA 85.

### 3.6.1 Water Treatment Testing

The boiler water shall be analyzed prior to the acceptance of the facility and a minimum of once a month for a period of 1 year by the water treatment company. The analysis shall include the following information recorded in accordance with ASTM D 596.

Date of Sample	[_____]	
Temperature	[_____]	degrees C
Silica (SiO <sub>2</sub> )	[_____]	ppm (mg/l)
Insoluble	[_____]	ppm (mg/l)
Iron and Aluminum Oxides	[_____]	ppm (mg/l)
Calcium (Ca)	[_____]	ppm (mg/l)
Magnesium (Mg)	[_____]	ppm (mg/l)
Sodium and Potassium (Na and K)	[_____]	ppm (mg/l)
Carbonate (HCO <sub>3</sub> )	[_____]	ppm (mg/l)
Sulfate (SO <sub>4</sub> )	[_____]	ppm (mg/l)
Chloride (Cl)	[_____]	ppm (mg/l)
Nitrate (NO <sub>3</sub> )	[_____]	ppm (mg/l)
Turbidity	[_____]	unit
pH	[_____]	
Residual Chlorine	[_____]	ppm (mg/l)
Total Alkalinity	[_____]	epm (meq/l)
Noncarbonate Hardness	[_____]	epm (meq/l)
Total Hardness	[_____]	epm (meq/l)
Dissolved Solids	[_____]	ppm (mg/l)
Fluorine	[_____]	ppm (mg/l)
Conductivity	[_____]	micro-mho/cm

If the boiler water is not in conformance with the boiler manufacturer's recommendations, the water treatment company shall take corrective action.

### 3.6.2 Boiler/Piping Test

At the conclusion of the 1 year period, the boiler and condensate piping shall be inspected for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water treatment company recommendations have been followed, the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

If corrosion is found within the condensate piping, proper repairs shall be made by the water treatment company.

### 3.7 CLEANING

#### 3.7.1 Boilers and Piping

After the hydrostatic tests have been made and before the system is balanced and operating tests are performed, the boilers and feed water piping shall be thoroughly cleaned by filling the system with a solution consisting of either 0.5 kg of caustic soda or 0.5 kg of trisodium phosphate per 190 L of water. The proper safety precautions shall be observed in the handling and use of these chemicals. The water shall be heated to approximately 65 degrees C and the solution circulated in the system for a period of 48 hours. The system shall then be drained and thoroughly flushed out with fresh water. Strainers and valves shall be thoroughly cleaned. Prior to operating tests, air shall be removed from all water systems by operating the air vents.

#### 3.7.2 Heating Units

Inside space heating equipment, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for fans that are operated during construction, and new filters shall be installed after construction dirt has been removed from the building, and the ducts, plenum, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

### 3.8 FUEL SYSTEM TESTS

#### 3.8.1 Gas System Test

The gas fuel system shall be tested in accordance with the test procedures outlined in NFPA 54.

### 3.9 FIELD TRAINING

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operation and maintenance instructions, as well as demonstrations of routine maintenance operations and boiler safety devices. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course.

-- End of Section --